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(54) Multilayer packaging film

(57) A multilayer packing film having improved properties of oxygen permability, transparency, flexibility and toughness and capable of being converted into pouches and bags upon conventional packaging machinery without distortion under heat-sealing conditions comprises a surface layer of a heat-sealable polymer, preferably a linear low density polyethylene, an oxygen barrier layer, of an ethylene/vinyl alcohol copolymer and a layer of polypropylene having an atactic content of 10% to 25% by weight which has a melting point substantially greater than the heat-sealable polymer, optionally bonded by a polymeric adhesive and preferably manufactured by coextrusion.

The multilayer film is particularly useful for packaging liquids where a high degree of resistance to cracking is required.

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SPECIFICATION

Multilayer packaging films

This invention is concerned with multilayer packaging films and in particular to films of high oxygen impermeability, transparency, flexibility and toughness.

Films of high oxygen impermeability are particularly useful for packaging foodstuffs, including liquids, which are spoilt by prolonged contact with oxygen. They normally comprise two or more layers including an outer layer of a readily heat-sealable polymer such as low density polyethylene together with an oxygen barrier layer such as an ethylene vinyl alcohol copolymer layer, a vinylidene chloride copolymer layer or a polymer layer carrying a metallised coating such as an aluminium coating formed by vacuum deposition.

Films, especially for use in packaging liquids, are preferably transparent sufficiently for the contents of the packages to be viewed and are required to be tough and flexible to withstand rough handling during transport so as to avoid cracking and pin-holing which would lead to leaking of contents from the packages and break down of the oxygen barrier.

One cause of physical weakness in films of the prior art arises from heat-sealing operations when the films are made into bags or pouches on conventional heat-sealing machinery. During such operations, films are brought together, heat-sealable surface to heat-sealable surface, and are sealed together by pressure between heated reciprocating heat-sealing jaws. All the layers of the film are softened, the film temporarily becomes more stretchable in the heat-seal area and under the influence of the tension in the film drawing the film through the machine there is a distinct tendency for the film to stretch and distort in the heat-seal area.

The object of the present invention is to provide improved multilayer packaging films having high oxygen impermeability and toughness.

According to the present invention a multilayer heat-sealable film having a high oxygen impermeability comprises a surface layer of a heat-sealable polymer capable of forming seals of adequate strength with itself under pressure at a temperature from about 80°C to about 130°C, an oxygen barrier layer of an ethylene vinyl alcohol copolymer and a layer of polypropylene having an atactic content in the range from about 10% to about 25% by weight.

Adjacent layers may conveniently be bonded together by a suitable "tie layer" consisting of a polymeric adhesive such as a polyolefin grafted with a monomer having polar functional groups. A suitable adhesive for use in this application is a "Plexar" resin marketed by Chemplex of Illinois of the United States of America. In a preferred method of manufacture of the multilayer film the layers, including the tie layers, are coextruded.

The heat-sealable polymer may be any of the conventional heat-sealable polymers well known in the packaging art preferably capable of forming seals of adequate strength at a temperature from about 90°C to about 120°C. Examples are low density polyethylene, an ethylene vinyl acetate copolymer, or an ionomer such as is marketed under the trade mark "Surlyn" by Du Pont of the United States of America. A particularly useful polymer for this purpose having a high degree of toughness and flexibility is a linear low density polyethylene alone or blended with other polymers such as low density polyethylene or ethylene/vinyl acetate. Such polymers are capable of forming seals of adequate strength under conditions of heat and pressure for usual packaging purposes, that is, seals of strength at ambient temperatures of at least 500 grams per 25 millimetres length of seal when measured by a seal peeling method.

The ethylene/vinyl alcohol copolymer layer preferably has a vinyl alcohol content in the range from 50 to 75% by weight to provide an oxygen barrier which is suitable for most packaging purposes where prevention of oxygen spoilage of the packaged contents is of prime importance.

The polypropylene layer preferably has an atactic content in the range from 15% to 20% by weight of the polypropylene. Such a layer is clear, tough and capable of being freely flexed without cracking. Further, since the melting point of the polypropylene layer is in the range of from 150°C to 165°C, during the normal heat-sealing conditions of the multilayer film (that is, the temperature at which the heat-sealable polymer layer is sealed) the integrity of the multilayer film is maintained by the polypropylene layer while under tension and thus distortion of the layers in the heat-seal area is avoided.

The invention also includes a method of manufacture of a multilayer heat-sealable film having a high oxygen impermeability comprising bringing together into surface contact a surface layer of a heat-sealable polymer capable of forming seals of adequate strength with itself under pressure at a temperature within the range from about 80 to 130°C, an oxygen barrier layer of an ethylene/vinyl alcohol copolymer and a layer of polypropylene having an atactic content in the range from about 10 to 25% by weight.

The invention will now be more particularly described by way of the following Example.

Example

A multilayer film consisting of three layers adhesively bonded to each other by tie layers was formed by extrusion in a molten state of the materials specified below through a flat coextrusion die followed by quenching upon a chilled roller. The order of feed of materials to the die and the dimensions of the die was such that the multilayer film was 90 microns in thickness and was made up of five layers in the following order :

Layer 1 – 56 microns in thickness – a linear low density polyethylene having a heat-sealing temperature of 115°C.

Layer 2 – 4 microns in thickness – an adhesive (tie) layer of a low density polyethylene modified by grafting to provide polar groups marketed by Chemplex of Illinois, United States of America, under the trade name "Plexar 158".

Layer 3 – 6 microns in thickness – an ethylene/vinyl alcohol in which the vinyl alcohol content was 70%.

Layer 4 – 4 microns in thickness – an adhesive layer of "Plexar 158" as in Layer 2.

Layer 5 – 20 microns in thickness – polypropylene having an atactic content of 16% by weight as marketed by Badische Anilin Soda Fabrik of Ludwigshaven, Germany, under the trade mark "Novolen" and having a melting point in the range 157-162°C.

By "heat-sealing temperature" is meant the temperature at which two layers of the material under consideration will seal together to provide on cooling a sealed film combination which requires a force of 1000 gms per linear 25 millimetres of seal to peel the layers apart.

The resulting film was clear and was readily converted into pouches and/or bags on conventional pouch and bag making machinery at normal speeds without distortion in the seal area. The film exhibited a high degree of flexibility and durability in use substantially without any sign of cracking or pin-holing and had an oxygen permeability of 1.0 millilitres per square metre per 24 hours under a pressure difference of one atmosphere and with a relative humidity of 75%.

Although reference has been made to coextrusion through a flat die it will be understood that a similar five layered multilayer film may be prepared by extrusion through a tubular coextrusion die.

The multilayer films of the present invention are particularly suited for forming into bags for the packaging of liquids which are susceptible to spoilage by oxidation, for example, wine.

CLAIMS

1. A multilayer heat-sealable film having a high oxygen impermeability comprising a surface layer of a heat-sealable polymer capable of forming seals of adequate strength with itself under pressure at a temperature within the range from about 80 to 130°C, an oxygen barrier layer of an ethylene/vinyl alcohol copolymer and a layer of polypropylene having an atactic content in the range from about 10 to 25% by weight.

2. A film on which the heat-sealable polymer is capable of forming seals of adequate strength at a temperature within the range from about 90°C to about 120°C.

3. A film as claimed in claim 1 or claim 2 in which the adjacent layers are bonded together by a tie layer consisting of a polymeric adhesive.

4. A film as claimed in claim 1, claim 2 or claim 3 in which the heat-sealable layer is low density polyethylene, an ethylene/vinyl acetate copolymer, a linear low density polyethylene alone or blended with low density polyethylene or an ethylene/vinyl acetate copolymer, or an ionomer.

5. A film as claimed in any one of the preceding claims in which the ethylene/vinyl alcohol has a vinyl alcohol content from 50 to 75% by weight.

6. A film as claimed in any one of the preceding claims in which the polypropylene layer has an atactic content in the range from 15% to 20% by weight.

7. A method of manufacture of a multilayer heat-sealable film having a high oxygen impermeability comprising bringing together into surface contact a surface layer of a heat-sealable polymer capable of forming seals of adequate strength with itself under pressure at a temperature within the range from about 80 to 130°C, an oxygen barrier layer of an ethylene/vinyl alcohol copolymer and a layer of polypropylene having an atactic content in the range from about 10 to 25% by weight.

8. A method as claimed in claim 7 in which adjacent layers are bonded together by a tie layer consisting of a polymeric adhesive.

9. A method as claimed in claim 7 or claim 8 in which the film is formed by coextrusion of all the layers.

10. A method as substantially described in the specific Example.

11. A film when manufactured in accordance with the method as claimed in claim 7, 8 or 9.

12. A pouch or bag when manufactured from a film as claimed in any one of the claims 1 to 6 and 11.

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